

IEM's AI Modeling: Short-term COVID-19 Projections

Date: 12/11/20

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 12/11/20 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

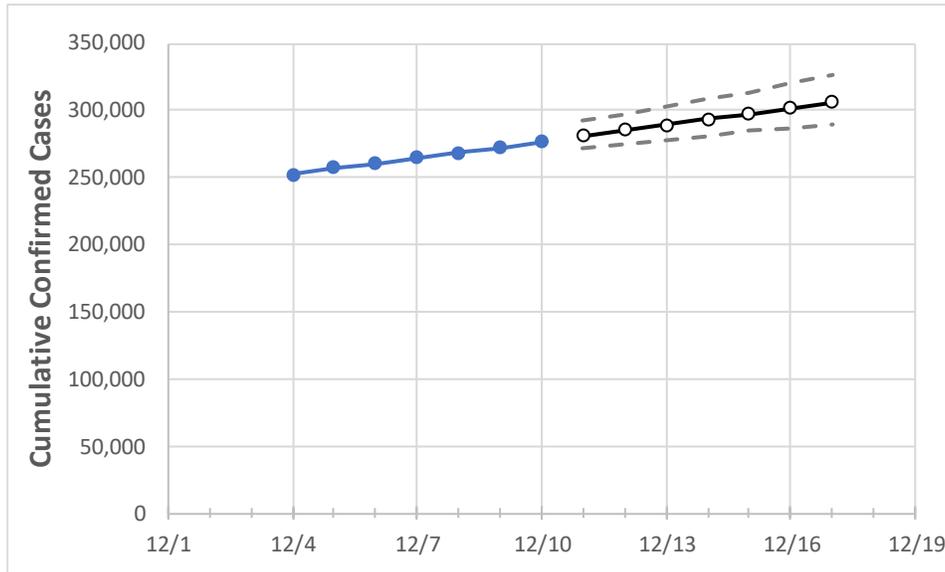
IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

Colorado State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17
Colorado	264,618	268,589	272,346	276,995	281,165	285,324	289,470	293,604	297,725	301,832	305,926

Note: The State’s projection shows a “best estimate” curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17
Adams	32,758	33,275	33,551	34,021	34,418	34,811	35,200	35,586	35,969	36,347	36,722
Arapahoe	30,569	30,989	31,320	31,763	32,188	32,612	33,033	33,453	33,870	34,286	34,700
Boulder	12,163	12,365	12,476	12,576	12,705	12,832	12,958	13,081	13,202	13,322	13,440
Denver	40,176	40,458	40,762	41,309	41,683	42,050	42,411	42,764	43,111	43,451	43,785
Douglas	12,349	12,542	12,741	12,947	13,148	13,349	13,548	13,747	13,944	14,140	14,335
Eagle	2,601	2,652	2,720	2,752	2,790	2,828	2,867	2,906	2,947	2,988	3,030
El Paso	31,738	32,288	33,019	33,618	34,259	34,904	35,551	36,201	36,854	37,510	38,169
Gunnison	508	512	513	518	521	525	529	532	536	540	544
Jefferson	23,842	24,203	24,443	24,779	25,146	25,512	25,877	26,240	26,602	26,962	27,321
Larimer	11,825	12,053	12,256	12,520	12,724	12,928	13,132	13,336	13,540	13,744	13,947
Pueblo	10,126	10,360	10,650	10,946	11,183	11,422	11,661	11,902	12,143	12,385	12,628
Weld	15,877	16,199	16,416	16,611	16,843	17,073	17,302	17,528	17,753	17,976	18,197

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- **Beds:** For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report ([MMWR, March 18, 2020](#)) and state reports of COVID-19 cases.
- **ICU:** The CDC report found that 24% of hospitalized cases require ICU care.
- **Ventilators:** Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.

Colorado Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:											
	12/7	12/8	12/9	12/10	12/12				12/14				12/16			
Adams	32,758	33,275	33,551	34,021	34,811	(6,962)	[1,671]	{835}	35,586	(7,117)	[1,708]	{854}	36,347	(7,269)	[1,745]	{872}
Arapahoe	30,569	30,989	31,320	31,763	32,612	(6,522)	[1,565]	{783}	33,453	(6,691)	[1,606]	{803}	34,286	(6,857)	[1,646]	{823}
Boulder	12,163	12,365	12,476	12,576	12,832	(2,566)	[616]	{308}	13,081	(2,616)	[628]	{314}	13,322	(2,664)	[639]	{320}
Denver	40,176	40,458	40,762	41,309	42,050	(8,410)	[2,018]	{1,009}	42,764	(8,553)	[2,053]	{1,026}	43,451	(8,690)	[2,086]	{1,043}
Douglas	12,349	12,542	12,741	12,947	13,349	(2,670)	[641]	{320}	13,747	(2,749)	[660]	{330}	14,140	(2,828)	[679]	{339}
Eagle	2,601	2,652	2,720	2,752	2,828	(566)	[136]	{68}	2,906	(581)	[140]	{70}	2,988	(598)	[143]	{72}
El Paso	31,738	32,288	33,019	33,618	34,904	(6,981)	[1,675]	{838}	36,201	(7,240)	[1,738]	{869}	37,510	(7,502)	[1,800]	{900}
Gunnison	508	512	513	518	525	(105)	[25]	{13}	532	(106)	[26]	{13}	540	(108)	[26]	{13}
Jefferson	23,842	24,203	24,443	24,779	25,512	(5,102)	[1,225]	{612}	26,240	(5,248)	[1,260]	{630}	26,962	(5,392)	[1,294]	{647}
Larimer	11,825	12,053	12,256	12,520	12,928	(2,586)	[621]	{310}	13,336	(2,667)	[640]	{320}	13,744	(2,749)	[660]	{330}
Pueblo	10,126	10,360	10,650	10,946	11,422	(2,284)	[548]	{274}	11,902	(2,380)	[571]	{286}	12,385	(2,477)	[594]	{297}
Weld	15,877	16,199	16,416	16,611	17,073	(3,415)	[820]	{410}	17,528	(3,506)	[841]	{421}	17,976	(3,595)	[863]	{431}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.